TI - Polygon mesh connection apparatus for 3D-CAD, 3D-CG - has polygon mesh data combination unit to combine data of two polygon meshes and completes connection process after detecting unnecessary overlapped polygon

PR - JP19960162663 19960624
PN - JP10011605 A 19980116 DW199813 G06T15/00 007pp
PA - (NIDE) NEC CORP
IC - G06T11/00 ;G06T15/00

AB - J10011605 The apparatus has a mean normal line calculator (11) which obtains a mean normal line of all polygons of a polygon mesh. An end point judging unit (12) judges whether the end point of the polygon mesh is a vertex. An intersection judging unit (13) judges a crossover in the polygon mesh in the linear length direction of the mean normal line from the end point. A threshold value judging unit (14) judges whether the obtained crossover is below a threshold value and determines the distance to the crossover.

- A polygon mesh deformation unit (15) rewrites the co-ordinate value of the crossover and deforms the mesh, when it is judged to be lower than the threshold value. A partial deletion unit (16) deletes the unnecessary overlapped polygon and the formed gap is filled by a new polygon generated from a new polygon generator (17). A polygon mesh data combination unit (18) combines the data of two polygon meshes and completes the connection process.

- ADVANTAGE - Prevents polygon overlap in connection part. Prevents influence of noise.

- (Dwg.1/7)

OPD - 1996-06-24
AN - 1998-135556 [13]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the conventional polygon mesh contact may be matched with the peak where the noise rode, when there is a noise, as shown in drawing 7 (A), and it may not be matched with the peak which should originally correspond.

[0006] Moreover, the case where the lap of a polygon arises in the connection which generated the new polygon depending on the configuration of the cut end of a polygon mesh on the occasion of stopgap processing is **. For example, by the conventional polygon generating method for matching the peak of one polygon mesh, and the edge (or the edge of one polygon mesh and the peak of another polygon mesh) of another polygon mesh, and generating a polygon after garbage deletion, supposing it comes to be shown in drawing 7 (B), no matter what matching it may carry out, there is a problem that a polygon will lap in a connection.

[0007] So, the technical problem of this invention is to offer the polygon mesh contact which connects the solid configurations (polygon mesh) expressed by the polygon.

CLAIMS

[Claim(s)]

[Claim 1] The polygon mesh contact characterized by providing the following A method-of-averaging line calculation means to search for the normal of an average of all the polygons of this polygon mesh in case the polygon mesh which presents two solid configurations expressed by the polygon which presents a polygon is connected An endpoint judging means to judge whether it is in the edge whose peak of the aforementioned polygon mesh is the aforementioned polygon mesh with the number of share polygons A decussation judging means by which the straight line lengthened in the direction of a method-of-averaging line for which it asked by the above-mentioned method-of-averaging line calculation means from the endpoint judges whether the polygon mesh for [another] connection is intersected A threshold judging means to judge whether it is below the threshold as which the distance to an intersection was beforehand determined in quest of the intersection when it crosses, The polygon mesh deformation means which rewrites to the coordinate value of the intersection which calculated the coordinate value of an endpoint, and transforms the aforementioned polygon mesh when it is below this threshold, A garbage means to delete the polygon which overlapped as a result of deformation and became unnecessary, The new polygon generation means which generates a new polygon and connects between the cut end produced as a result of deletion, and the aforementioned polygon mesh for connection, and the polygon mesh-data unification means which makes data of the two aforementioned polygon mesh one polygon mesh data

[Claim 2] The polygon mesh contact characterized by providing the following A method-of-averaging line calculation means to search for the normal of an average of all the polygons of this polygon mesh in case the polygon mesh which presents two solid configurations expressed by the polygon which presents a polygon is connected An endpoint judging means to judge whether it is in the edge whose peak of the aforementioned polygon mesh is the aforementioned polygon mesh with the number of share polygons A decussation judging means by which the straight line lengthened in the direction of a method-of-averaging line for which it asked by the above-mentioned method-of-averaging line calculation means from the endpoint judges whether the polygon mesh for [another] connection is intersected A threshold

judging means to judge whether it is below the threshold as which the distance to an intersection was beforehand determined in quest of the intersection when it crosses, The polygon mesh deformation means which rewrites to the coordinate value of the intersection which calculated the coordinate value of an endpoint, and transforms the aforementioned polygon mesh when it is below this threshold, A polygon mesh division means to divide the polygon of another polygon mesh for connection along with the profile of the aforementioned polygon, A garbage means to delete the polygon which overlapped as a result of deformation and became unnecessary, and the polygon mesh-data unification means which makes data of two polygon mesh one polygon mesh data

[Claim 3] In a polygon mesh contact according to claim 2 the aforementioned polygon mesh division means The two peaks of a polygon with a polygon mesh as a result of the aforementioned polygon mesh deformation means When moving onto the polygon from which another polygon mesh differs The polygon mesh contact characterized by being what finds the curtate distance of an edge and the edge of the polygon of the polygon mesh of a movement place, generates the point on the edge of a polygon mesh which takes a curtate distance as the new peak, generates a polygon further, and deletes a polygon.

[Claim 4] It is the polygon mesh contact characterized by operating the polygon of one aforementioned polygon mesh orthopedically in order that the aforementioned polygon mesh division means may make polygon division of the aforementioned polygon mesh easy to perform in a polygon mesh contact according to claim 2.

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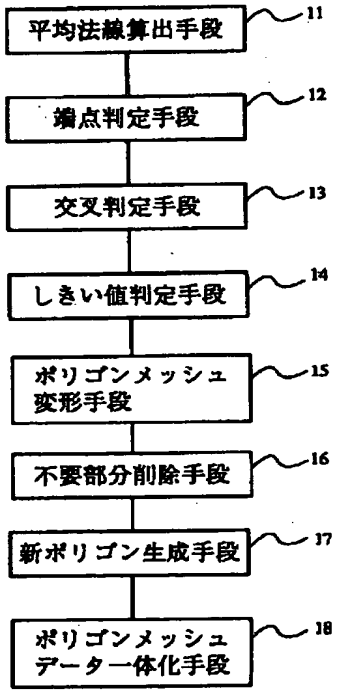
(54)【発明の名称】　ポリゴンメッシュ接続装置

(57)【要約】
【課題】　ノイズの影響を減少し、接続部分でポリゴンが重なることがないようにすること。
【解決手段】　平均法線算出手段１１と、頂点が端点であるかどうかを判定する端点判定手段１２と、交叉を判定する交叉判定手段１３と、しきい値以下であるかを判定するしきい値判定手段１４と、ポリゴンメッシュ変形手段１５と、不要になったポリゴンの削除の結果生じた隙間を新ポリゴン生成手段１７において新たなポリゴンを生成して穴埋めを行なう不要部分削除手段１６と、２つのポリゴンメッシュのデータを一つのデータにして接続処理を完了させるポリゴンメッシュデータ一体化手段１８とを有している。



【特許請求の範囲】
【請求項１】　多角形を呈するポリゴンで表現された２つの立体形状を呈するポリゴンメッシュを接続する際に、該ポリゴンメッシュの全てのポリゴンの平均の法線を求める平均法線算出手段と、前記ポリゴンメッシュの頂点が前記ポリゴンメッシュの端にあるかどうかを共有ポリゴンの数により判定する端点判定手段と、端点から上記平均法線算出手段により求めた平均法線方向に伸ばした直線が、もう一方の接続対象のポリゴンメッシュと交叉するかどうかを判定する交叉判定手段と、交叉する場合に、交点を求め交点までの距離があらかじめ定められたしきい値以下であるかを判定するしきい値判定手段と、該しきい値以下であった場合に、端点の座標値を求めた交点の座標値に書き換えて前記ポリゴンメッシュの変形を行なうポリゴンメッシュ変形手段と、変形の結果重複して不要となったポリゴンを削除する不要部分手段と、削除の結果生じた切口と接続対象の前記ポリゴンメッシュの間を新たなポリゴンを生成してつなぎ合わせる新ポリゴン生成手段と、２つの前記ポリゴンメッシュのデータを一つのポリゴンメッシュデータにするポリゴンメッシュデータ一体化手段とを有していることを特徴とするポリゴンメッシュ接続装置。
【請求項２】　多角形を呈するポリゴンで表現された２つの立体形状を呈するポリゴンメッシュを接続する際に、該ポリゴンメッシュの全てのポリゴンの平均の法線を求める平均法線算出手段と、前記ポリゴンメッシュの頂点が前記ポリゴンメッシュの端にあるかどうかを共有ポリゴンの数により判定する端点判定手段と、端点から上記平均法線算出手段により求めた平均法線方向に伸ばした直線が、もう一方の接続対象のポリゴンメッシュと交叉するかどうかを判定する交叉判定手段と、交叉する場合に、交点を求め交点までの距離があらかじめ定められたしきい値以下であるかを判定するしきい値判定手段と、該しきい値以下であった場合に、端点の座標値を求めた交点の座標値に書き換えて前記ポリゴンメッシュの変形を行なうポリゴンメッシュ変形手段と、前記ポリゴンの輪郭に沿って、接続対象のもう一方のポリゴンメッシュのポリゴンの分割を行なうポリゴンメッシュ分割手段と、変形の結果重複して不要となったポリゴンを削除する不要部分手段と、２つのポリゴンメッシュのデータを一つのポリゴンメッシュデータにするポリゴンメッシュデータ一体化手段とを有していることを特徴とするポリゴンメッシュ接続装置。
【請求項３】　請求項２記載のポリゴンメッシュ接続装置において、前記ポリゴンメッシュ分割手段は、前記ポリゴンメッシュ変形手段の結果、もしポリゴンメッシュのあるポリゴンの２つの頂点が、もう一方のポリゴンメッシュの異なるポリゴン上に移動していた場合に、エッジと移動先のポリゴンメッシュのポリゴンのエッジとの最短距離を求め、最短距離をとるようなポリゴンメッシュのエッジ上の点を新たな頂点として生成し、さらにポリゴンを生成し、ポリゴンを削除するものであることを特徴とするポリゴンメッシュ接続装置。
【請求項４】　請求項２記載のポリゴンメッシュ接続装置において、前記ポリゴンメッシュ分割手段は、前記ポリゴンメッシュのポリゴン分割を行ないやすくするために、一方の前記ポリゴンメッシュのポリゴンの整形を行なうことを特徴とするポリゴンメッシュ接続装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、３次元ＣＡＤや３次元ＣＧの分野において使用される３次元モデルを作製する際に、ポリゴンで表現された立体形状（ポリゴンメッシュ）同士を接続するためのポリゴンメッシュ接続装置に属する。
【０００２】
【従来の技術】従来のポリゴンメッシュ接続装置としては、３D映像Ｖｏｌ．１０　Ｎｏ．１，ｐｐ．２４－３１（１９９６）に記載の藤原：『３次元形状計測システムＶＩＶＩＤにおけるデータ処理』がある。
【０００３】このポリゴンメッシュ接続装置は、レンジファインダにより多視点から距離画像を計測し、カメラ情報に基づく位置合わせを行ない接続を行なう方式を用いたものである。この方式では２つのポリゴンメッシュを接続する際に、一方のポリゴンメッシュの各頂点に対し、もう一方のポリゴンメッシュの頂点のうちもっとも近い頂点を見つけ対応付ける。その後、頂点密度をもとに重み付け平均処理を行ない算出した座標位置に双方の対応点を移動する。ここでは、頂点密度の高い方がデータの精度や信頼性が高いものとして重み付けを行なっている。そして、移動の結果、重なり合ったポリゴンを不要部分として一旦すべて削除し、削除後に生じた隙間に新たにポリゴンを張って接続部分を生成して、接続を行なっている。
【０００４】従来のポリゴンメッシュ接続装置においては、図７（Ａ）に示すように、ノイズがある場合にノイズの乗った頂点と対応付けられる。
【０００５】
【発明が解決しようとする課題】しかしながら、従来のポリゴンメッシュ接続装置は、図７（Ａ）に示したように、ノイズがある場合にノイズの乗った頂点と対応付けられてしまい、本来対応するはずの頂点と対応付けられないことがある。
【０００６】また、穴埋め処理の際にポリゴンメッシュの切口の形状によっては、新たなポリゴンを生成した接続部でポリゴンの重なりが生じる場合がある。たとえば、不要部分削除後に、図７（Ｂ）に示すようになったとすると、一方のポリゴンメッシュの頂点と、もう一方のポリゴンメッシュのエッジ（あるいは一方のポリゴンメッシュのエッジともう一方のポリゴンメッシュの頂点）を

頂点が定める三角錐の内側にあるかどうかで判定する。

【００１４】前処理としてまず、ポリゴンメッシュＡの頂点Ｐからポリゴンメッシュ Ｂのポリゴンの３頂点Ｃ，Ｃ′ Ｃ″ へのベクトルｃ＝（c_{11}，c_{12}，c_{13}）、ｃ′＝（c_{21}，c_{22}，c_{23}）、ｃ″＝（c_{31}，c_{32}，c_{33}）を求める。そして、ポリゴンメッシュＡの頂点の法線ベクトルｖ＝（v_1，v_2，v_3）に対し、ｖ＝r_1 ｃ＋r_2 ｃ′＋r_3 ｃ″ を満たすような３定数r_1，r_2，r_3 を求める。

【００１５】これがすべて正、または負であれば、ｖはポリゴンメッシュＢのあるポリゴンと交叉することになる。

【００１６】ｖ＝r_1 ｃ＋r_2 ｃ′＋r_3 ｃ″ を行列表現すると、表１のようになる。

【００１７】

【表１】

$$\begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} = \begin{pmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{pmatrix} \begin{pmatrix} r_1 \\ r_2 \\ r_3 \end{pmatrix}$$

よって、r_1，r_2，r_3 を求めるには逆行列をかければよい。

【００１８】すなわち、表２となる。

【００１９】

【表２】

$$\begin{pmatrix} r_1 \\ r_2 \\ r_3 \end{pmatrix} = \begin{pmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{pmatrix}^{-1} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

そして、交叉すると判定された場合にはしきい値判定手段１４において、平均法線とポリゴンメッシュＢの交点を求め、さらに交点までの距離があらかじめ定めておいたしきい値以下であるかを判定する。しきい値以下だった場合にはその交点を対応点とする。もし、このような対応点が一つもなかった場合には、接続処理は行なわない。

【００２０】以下、この交点の求め方を説明する。ポリゴンメッシュＡの頂点Ｐから求める交点へのベクトルはある定数ｔを用いて、ｔｖとかける。よって、求める交点から法線が交叉するポリゴンの頂点Ｃへのベクトルはｃ－ｔｖとなるが、このベクトルはポリゴン上に乗っているので、ポリゴンの法線ベクトルをｎとすれば、その内積は０となる。すなわち（ｃ－ｔｖ，ｎ）＝０が成り立つ。これは（ｃ，ｎ）－ｔ（ｖ，ｎ）＝０と変形できるので、ｔ＝（ｃ，ｎ）／（ｖ，ｎ）を得る。よって、求める交点のベクトルは（ｃ，ｎ）／（ｖ，ｎ）・ｖとなる。

【００２１】次に、ポリゴンメッシュ変形手段１５において、しきい値判定手段１４で求めた交点にポリゴンメッシュＡの端点を移動することで、ポリゴンメッシュＡの変形を行なう。

【００２２】さらに、移動したポリゴンメッシュＡの頂点を基準としてＡの各頂点に移動パラメータを設定し、その移動パラメータに応じて移動を行ないポリゴンメッシュＡを変形すれば、接続部分をより滑らかにすることができる。

【００２３】移動パラメータの設定方法は、以下の通りである。まずＡの各頂点に対しその隣点を調べ、隣点のなかで移動頂点（これを移動パラメータ０とする）であるものが存在した場合、その頂点の移動パラメータを１とし、さらに移動パラメータ０の頂点の移動がｔｕであったとき、０．５ｔｕだけ移動する。以下同様に移動パラメータ未設定の頂点に対しその隣点を調べ、隣点のなかで移動パラメータがｐ－１であるものが存在した場合、移動パラメータとしてｐを設定し、さらに移動パラメータｐ－１の移動量の０．５倍だけ移動する。これを未設定の頂点がなくなるまで続ける。こうすることで、移動パラメータｐの頂点は０．５Ｐ ｔｕとなり、移動パラメータに応じた移動が行なえる。

【００２４】そして、不要部分削除手段１６において、ポリゴンメッシュ変形手段１５の結果、重なったポリゴンを削除する。

【００２５】さらに新ポリゴンを生成手段１７において、不要部分削除手段１６の結果生じた隙間を、新たにポリゴンを生成して穴埋め処理を行ない、ポリゴンメッシュデータ一体化手段１８において、ポリゴンメッシュＡとＢの同じ位置にある頂点のデータを統合し、一つのポリゴンメッシュデータに一体化する。

【００２６】図３乃至図６は、本発明のポリゴンメッシュ接続装置の第２の実施の形態例を示している。第２の実施の形態例のポリゴンメッシュ接続装置では、第１の実施の形態例のポリゴンメッシュ接続装置のポリゴンメッシュ変形手段１５と不要部分削除手段１６との間にポリゴンメッシュ分割手段２１を備えることによって新ポリゴン生成手段１７を不要としている。

【００２７】即ち、第１の実施の形態例のポリゴンメッシュ接続装置に加えて、ポリゴンの輪郭に沿って、接続対象のもう一方のポリゴンメッシュＢのポリゴンの分割を行なうポリゴンメッシュ分割手段２１を備えており、その結果として第１の実施に形態例の新ポリゴン生成手段１７を必要としないポリゴンメッシュ接続装置である。

【００２８】ポリゴンメッシュ変形手段１５の結果、図４に示すように、もしポリゴンメッシュ（ｍｅｓｈＡ）Ａのあるポリゴンの２つの頂点（Ｅ，Ｆとする）が、ポリゴンメッシュＢの異なるポリゴン上に移動していた場

合には、ポリゴンメッシュ分割手段２１において、そのエッジＥ、Ｆと移動先のポリゴンメッシュ（ｍｅｓｈＢ）Ｂのポリゴンのエッジとの最短距離を求め、最短距離をとるようなポリゴンメッシュＢのエッジ上の点を新たな頂点Ｈとして生成し、さらにポリゴンＧ，Ｅ，Ｈ、及びＧ，Ｆ，Ｈを生成する。その後、ポリゴンＥ，Ｆ，Ｇを削除する。

【００２９】その後、図５に示すように、ポリゴンメッシュＢのポリゴン分割を行ないやすくするため、ポリゴンメッシュＡのポリゴンの整形を行なう。

【００３０】まず、ポリゴンメッシュＡの各ポリゴンに対しその頂点の移動先のポリゴンメッシュＢのポリゴンを調べる。もし３頂点とも同じポリゴンメッシュＢのポリゴン内に移動していた場合、そのポリゴンを削除する。もし２頂点が同じポリゴンに移動していて、かつどちらかの頂点がポリゴンメッシュＢのエッジ上にある場合（これをＳとし、エッジ上にない方の頂点はＴとする）、頂点ＴをＳに移動した後Ｓ，Ｔをエッジとするポリゴンｐを削除する。

【００３１】次に，ポリゴンメッシュＢの分割について図６を用いて説明する。ポリゴンメッシュＢの各エッジに対し、そのエッジ上にポリゴンメッシュＡの新たな頂点が生成されていた場合、その位置にポリゴンメッシュＢの新たな頂点Ｗを生成し、さらにエッジの向かいにある頂点Ｗ´と頂点Ｗの間でエッジを生成して、ポリゴン分割を行ない、接続部分のメッシュ細分化を行なう。そして、頂点Ｖを生成し、さらにエッジの向かいにある頂点Ｖ´と頂点Ｖの間でエッジを生成して、ポリゴン分割を行なう。

【００３２】したがって、ポリゴンメッシュＡの輪郭に沿ってポリゴンメッシュＢを分割するので、不要部分削除手段１６を行なっても隙間が生じず、新ポリゴン生成手段１７は行なう必要が無い。

【００３３】

【発明の効果】本発明では、ポリゴンメッシュの輪郭を平均法線方向に接続対象のポリゴンメッシュに投影することで、対応付けを行ない、平均方線を使っているので、ノイズの影響を受けることが少ない。

【００３４】また、あらかじめポリゴンメッシュの輪郭に沿ってポリゴン分割を行なってから不要部分の削除を行なうので、接続部分でポリゴンが重なることがない。

【図面の簡単な説明】

【図１】本発明のポリゴンメッシュ接続装置の第１の実施に形態例を示すブロック図である。

【図２】図１に示したポリゴンメッシュ接続装置の処理の流れを説明するフローチャートである。

【図３】本発明のポリゴンメッシュ接続装置の第２の実施に形態例を示すブロック図である。

【図４】図３に示したポリゴンメッシュ接続装置のポリゴンメッシュ分割手段を説明する説明図である。

【図５】図３に示したポリゴンメッシュ接続装置のポリゴンメッシュ分割手段を説明する説明図である。

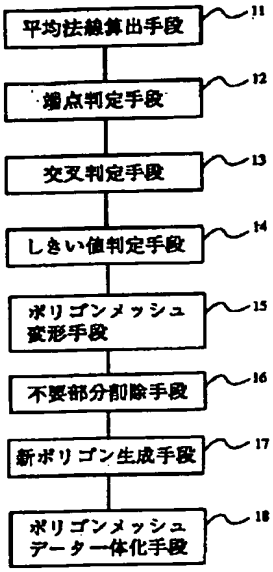
【図６】図３に示したポリゴンメッシュ接続装置のポリゴンメッシュ分割手段を説明する説明図である。

【図７】従来のポリゴンメッシュ接続装置におけるノイズの乗った頂点との対応付けを説明した説明図である。

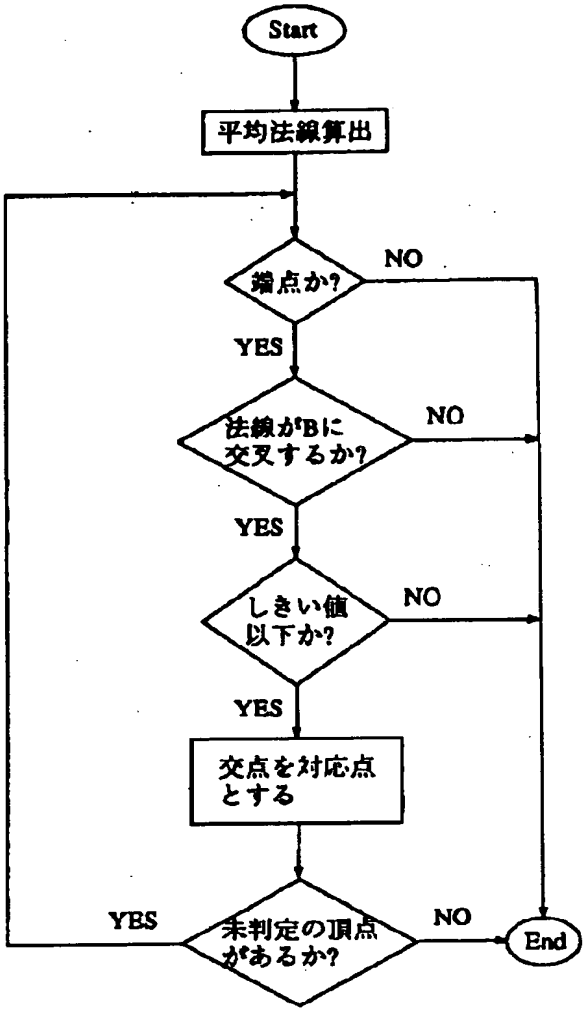
【符号の説明】

１１　平均法線算出手段
１２　端点判定手段
１３　交叉判定手段
１４　しきい値判定手段
１５　ポリゴンメッシュ変形手段
１６　不要部分削除手段
１７　新ポリゴン生成手段
１８　ポリゴンメッシュデーター一体化手段
２１　ポリゴンメッシュ分割手段

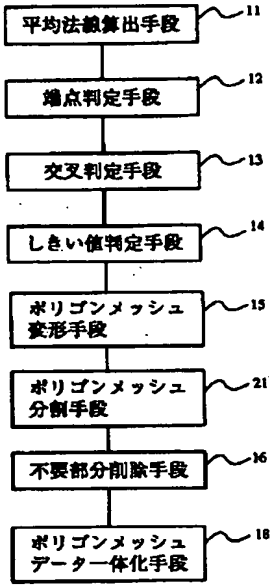
【図1】


平均法線算出手段
11
端点判定手段
12
交叉判定手段
13
しきい値判定手段
14
ポリゴンメッシュ変形手段
15
不要部分削除手段
16
新ポリゴン生成手段
17
ポリゴンメッシュデーター体化手段
18

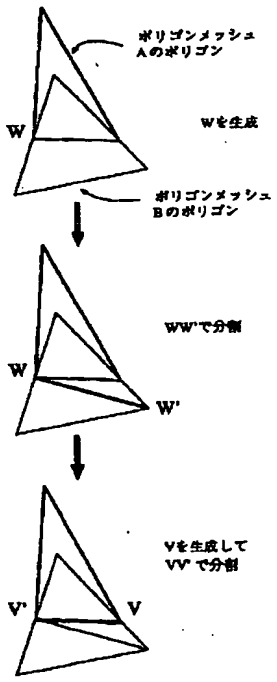
【図2】


Start
平均法線算出
端点か?
NO
YES
法線がBに交叉するか?
NO
YES
しきい値以下か?
NO
YES
交点を対応点とする
未判定の頂点があるか?
YES
NO
End

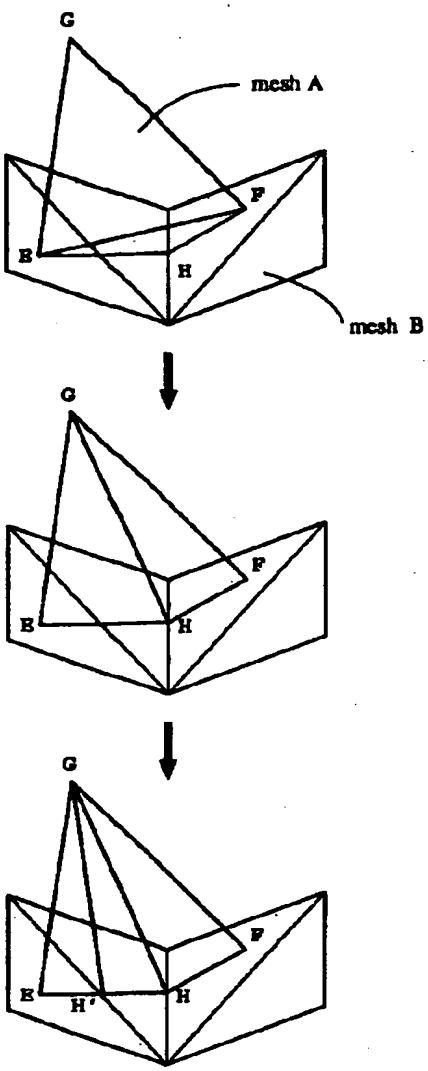
【図3】


平均法線算出手段
11
端点判定手段
12
交叉判定手段
13
しきい値判定手段
14
ポリゴンメッシュ変形手段
15
ポリゴンメッシュ分割手段
21
不要部分削除手段
16
ポリゴンメッシュデーター体化手段
18

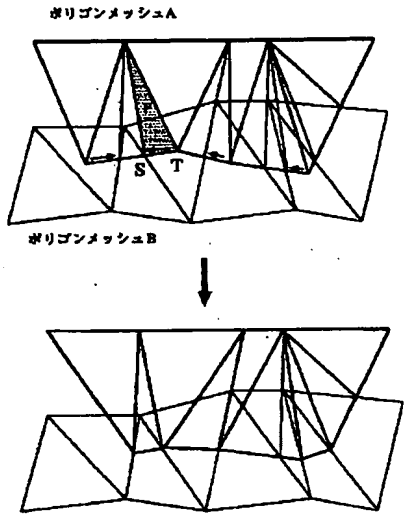
【図6】


ポリゴンメッシュAのポリゴン
Wを生成
W
ポリゴンメッシュBのポリゴン
WW'で分割
W
W'
Vを生成してVV'で分割
V'
V

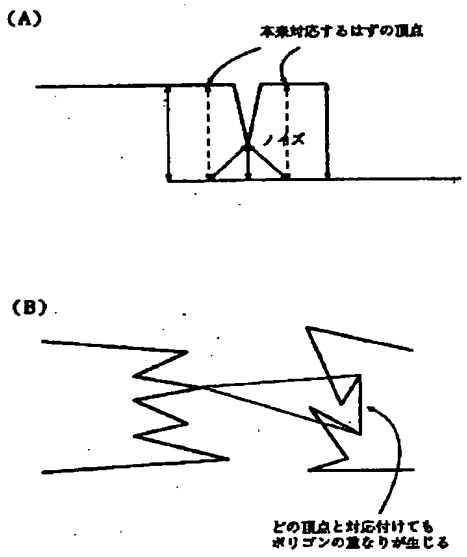
【図4】


G
mesh A
F
E
H
mesh B
G
F
E
H
G
F
E
H'
H

【図5】


ポリゴンメッシュA
S
T
ポリゴンメッシュB

【図7】


(A)
本来対応するはずの頂点
ノイズ
(B)
どの頂点と対応付けても
ポリゴンの重なりが生じる

PATENT ABSTRACTS OF JAPAN

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G06T 11/00

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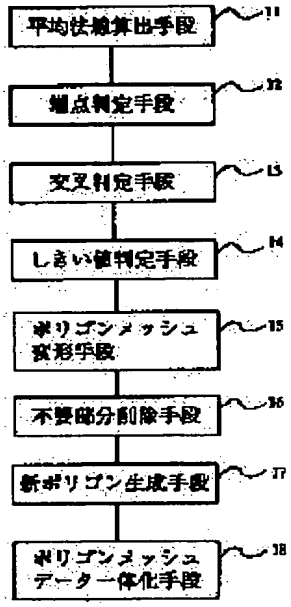
!)Date of filing : 24.06.1996

(71)Applicant : NEC CORP
(72)Inventor : TANAKA MIKIHIRO

!) POLYGON MESH CONNECTION DEVICE

')Abstract:
:OBLEM TO BE SOLVED: To reduce the influence of noise and to
›vent the overlap of polygons in a connection part by projecting the
tline of a polygon mesh on the polygon mesh of a connection object in
› direction of an average normal to make them correspond to each other
d using the average normal.
)LUTION: The outline of the polygon mesh is projected on the polygon
:sh of the connection object in the direction of the average normal to
ke them correspond to each other and the average normal is used. The
ygon is previously divided along the outline of the polygon mesh and an
›ecessary part is eliminated. In the device, and average normal
culation means 11 averages the normal vector of all the polygons. An
›ecessary part elimination means 16 fills in a clearance generates as the
:ult of the elimination of the polygon which becomes unnecessary by
›erating the new polygon in a new polygon generation means 17. A
ygon mesh data integration means 18 makes data of the two polygon
:shes into one data and completed a connection processing.



GAL STATUS

ate of request for examination]	24.06.1996
ate of sending the examiner's decision of rejection]	
nd of final disposal of application other than the aminer's decision of rejection or application converted gistration]	
ate of final disposal for application]	
atent number]	2755293
ate of registration]	06.03.1998
umber of appeal against examiner's decision of ection]	
ate of requesting appeal against examiner's decision of ection]	
ate of extinction of right]	

AIMS

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aim(s)]
aim 1] A method-of-averaging line calculation means to ask for the normal of an average of all the polygons of this ygon mesh in case the polygon mesh which presents two solid configurations expressed by the polygon which sents a polygon is connected, An endpoint judging means to judge whether it is in the edge whose top-most vertices said polygon mesh are said polygon mesh with the number of share polygons, A decussation judging means by which straight line lengthened in the direction of a method-of-averaging line searched for with the above-mentioned thod-of-averaging line calculation means from the endpoint judges whether the polygon mesh for [another] nection is intersected, A threshold judging means to judge whether it is below the threshold as which the distance by intersection was beforehand determined in quest of the intersection when it crosses, The polygon mesh deformation ans which rewrites to the coordinate value of the intersection which calculated the coordinate value of an endpoint, l transforms said polygon mesh when it is this below threshold, A garbage means to delete the polygon which rlapped as a result of deformation and became unnecessary, The new polygon generation means which generates a v polygon and connects between the cut end produced as a result of deletion, and said polygon mesh for connection, e polygon mesh contact characterized by having the polygon mesh-data unification means which makes data of said polygon mesh one polygon mesh data.
aim 2] A method-of-averaging line calculation means to ask for the normal of an average of all the polygons of this ygon mesh in case the polygon mesh which presents two solid configurations expressed by the polygon which sents a polygon is connected, An endpoint judging means to judge whether it is in the edge whose top-most vertices said polygon mesh are said polygon mesh with the number of share polygons, A decussation judging means by which straight line lengthened in the direction of a method-of-averaging line searched for with the above-mentioned thod-of-averaging line calculation means from the endpoint judges whether the polygon mesh for [another] nection is intersected, A threshold judging means to judge whether it is below the threshold as which the distance by intersection was beforehand determined in quest of the intersection when it crosses, The polygon mesh deformation ans which rewrites to the coordinate value of the intersection which calculated the coordinate value of an endpoint, l transforms said polygon mesh when it is this below threshold, A polygon mesh division means to divide the ygon of another polygon mesh for connection along with the profile of said polygon, The polygon mesh contact racterized by having a garbage means to delete the polygon which overlapped as a result of deformation and became necessary, and the polygon mesh-data unification means which makes data of two polygon mesh one polygon mesh a.
aim 3] In a polygon mesh contact according to claim 2 said polygon mesh division means Two top-most vertices of a ygon with a polygon mesh as a result of said polygon mesh deformation means When moving onto the polygon from ich another polygon mesh differs The polygon mesh contact characterized by being what finds the minimum distance an edge and the edge of the polygon of the polygon mesh of a migration place, generates the point on the edge of a ygon mesh which takes the minimum distance as new top-most vertices, generates a polygon further, and deletes a ygon.
aim 4] It is the polygon mesh contact characterized by operating the polygon of one of said polygon mesh hopedically in order that said polygon mesh division means may make polygon division of said polygon mesh easy to form in a polygon mesh contact according to claim 2.

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anslation done.]

NOTICES *

pan Patent Office is not responsible for any
nages caused by the use of this translation.

This document has been translated by computer. So the translation may not reflect the original precisely.
*** shows the word which can not be translated.
n the drawings, any words are not translated.

TAILED DESCRIPTION

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etailed Description of the Invention]
)01]
eld of the Invention] In case this invention produces the three-dimension model used in the field of three dimensional
D or three-dimension CG, it belongs to the polygon mesh contact for connecting the solid configurations (polygon
sh) expressed by the polygon.
)02]
escription of the Prior Art] As a conventional polygon mesh contact, it is 3-D image Vol.10. Fujiwara [of a
olication]: "data processing in the three-dimension shape-measurement system VIVID" is in No.1 and pp.24-31
)96).
)03] This polygon mesh contact measures a depth map from a multiaspect with a range finder, and the method which
nects by performing alignment based on camera information is used for it. By this method, in case two polygon
sh are connected, the nearest top-most vertices are found and matched among top-most vertices of another polygon
sh to each top-most vertices of one polygon mesh. Then, both corresponding points are moved to the coordinate
ation which computed by performing weighting average processing based on the top-most-vertices consistency.
re, the one where a top-most-vertices consistency is higher is performing weighting as what has a high precision and
dependability of data. And as a result of migration, the overlapping polygons were once altogether deleted as a
bage, and it has connected by newly stretching a polygon in the clearance produced after deletion, and generating a
nection part.
)04] In the conventional polygon mesh contact, as shown in drawing 7 (A), when there is a noise, it is matched with
top-most vertices where the noise rode.
)05]
oblem(s) to be Solved by the Invention] However, the conventional polygon mesh contact may be matched with the
-most vertices where the noise rode when there is a noise, as shown in drawing 7 (A), and it may not be matched
h the top-most vertices which should originally correspond.
)06] Moreover, the case where the lap of a polygon arises in the connection which generated a new polygon
pending on the configuration of the cut end of a polygon mesh on the occasion of stopgap processing is **. For
mple, by the conventional polygon generating method for matching top-most vertices of one polygon mesh, and the
e (or the edge of one polygon mesh and top-most vertices of another polygon mesh) of another polygon mesh, and
nerating a polygon after garbage deletion, supposing it comes to be shown in drawing 7 (B), no matter what matching
nay carry out, there is a problem that a polygon will lap in a connection.
)07] So, the technical problem of this invention is to offer the polygon mesh contact which connects the solid
nfigurations (polygon mesh) expressed by the polygon.
)08]
eans for Solving the Problem] A method-of-averaging line calculation means to ask for the normal of an average of
the polygons of this polygon mesh in case the polygon mesh which presents two solid configurations expressed by
polygon which presents a polygon is connected according to this invention, An endpoint judging means to judge
ether it is in the edge whose top-most vertices of said polygon mesh are said polygon mesh with the number of share
lygons, A decussation judging means by which the straight line lengthened in the direction of a method-of-averaging
e searched for with the above-mentioned method-of-averaging line calculation means from the endpoint judges
ether the polygon mesh for [another] connection is intersected, A threshold judging means to judge whether it is
ow the threshold as which the distance by the intersection was beforehand determined in quest of the intersection
en it crosses, The polygon mesh deformation means which rewrites to the coordinate value of the intersection which

culated the coordinate value of an endpoint, and transforms said polygon mesh when it is this below threshold, A :bage means to delete the polygon which overlapped as a result of deformation and became unnecessary, The new lygon generation means which generates a new polygon and connects between the cut end produced as a result of .etion, and said polygon mesh for connection, The polygon mesh contact characterized by having the polygon mesh- :a unification means which makes data of said two polygon mesh one polygon mesh data is obtained.

)09] Moreover, a method-of-averaging line calculation means to ask for the normal of an average of all the polygons this polygon mesh in case the polygon mesh which presents two solid configurations expressed by the polygon which :sents a polygon is connected according to this invention, An endpoint judging means to judge whether it is in the ge whose top-most vertices of said polygon mesh are said polygon mesh with the number of share polygons, A :ussation judging means by which the straight line lengthened in the direction of a method-of-averaging line searched with the above-mentioned method-of-averaging line calculation means from the endpoint judges whether the lygon mesh for [another] connection is intersected, A threshold judging means to judge whether it is below the eshold as which the distance by the intersection was beforehand determined in quest of the intersection when it sses, The polygon mesh deformation means which rewrites to the coordinate value of the intersection which culated the coordinate value of an endpoint, and transforms said polygon mesh when it is this below threshold, A lygon mesh division means to divide the polygon of another polygon mesh for connection along with the profile of d polygon, The polygon mesh contact characterized by having a garbage means to delete the polygon which erlapped as a result of deformation and became unnecessary, and the polygon mesh-data unification means which kes data of two polygon mesh one polygon mesh data is obtained.

)10]

nbodiment of the Invention] The example of a gestalt of operation of the 1st of the polygon mesh contact of this ention is explained with reference to drawing 1 and drawing 2 .

)11] Connection of two polygon mesh is considered by that of the polygon mesh contact of the example of a gestalt of s 1st operation. In addition, suppose that the conditions that it sees from [of that polygon mesh] a method-of- eraging line, and all the parts of a polygon mesh can be seen about one polygon mesh (it hides and there is no field) fulfilled about the configuration of a polygon mesh (this polygon mesh is set to A.). Since a configuration like a ball the anchor ring is excepted from this condition, it is guaranteed that an endpoint exists in the polygon mesh A. There especially no conditions about the configuration of another polygon mesh (this polygon mesh is set to B). Moreover, polygon mesh A and B may be divided into plurality.

)12] A method-of-averaging line calculation means 11 to ask for the normal of an average of all the polygons of the lygon mesh A and B in case a polygon mesh contact connects two solid configurations (polygon mesh A and B) pressed with the polygon (polygon), An endpoint judging means 12 to judge whether it is in the edge whose top-most tices of a polygon mesh are a polygon mesh with the number of share polygons, A decussation judging means by ich the straight line lengthened in the direction of a method-of-averaging line searched for with the method-of- eraging line calculation means 11 from the endpoint judges whether the polygon mesh A for [another] connection is ersected, A threshold judging means 14 to judge whether it is below the threshold as which the distance by the ersection was beforehand determined in quest of the intersection when it crosses, The polygon mesh deformation ans 15 which rewrites to the coordinate value of the intersection which calculated the coordinate value of an dpoint, and transforms a polygon mesh when it is below a threshold, A garbage means 16 to delete the polygon which erlapped as a result of deformation and became unnecessary, The new polygon generation means 17 which generates ew polygon and connects between the cut end produced as a result of deletion, and the polygon mesh for connection, as the polygon mesh-data unification means 18 which makes data of two polygon mesh A and B one polygon mesh a.

)13] First, with the average normal calculation means 11, the normal vector of all the polygons of the polygon mesh s computed, it is equalized, and it asks for average normal vector v. Next, in the endpoint judging means 12, it judges ether the top-most vertices of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. are endpoints on h top-most vertices of the polygon mesh A. Next, in the decussation judging means 13, it judges whether the normal gthened in the direction v of a method-of-averaging line for which each endpoint of the polygon mesh A was asked h the method-of-averaging line calculation means 11 from the endpoint of opposite Perilla frutescens (L.) Britton . crispa (Thunb.) Decne. intersects the polygon of the polygon mesh B. This judgment is judged by whether there is normal from top-most vertices of the polygon mesh A inside the triangular pyramid which top-most vertices of the lygon mesh A and three top-most vertices of the polygon of the polygon mesh B define.

)14] pretreatment -- ****** -- first -- a polygon -- a mesh -- A -- top-most vertices -- P -- from -- a polygon -- a mesh 3 -- a polygon -- three -- top-most vertices -- C -- C -- ' -- C -- " -- a vector -- c -- = (c11, c12, c13) -- c -- ' -- = (c21,

!, c23) -- c -- " -- = (c31, c32, c33) -- asking . And three constants r1 which fill v=r1 c+r2 c'+r3 c" to normal vector (v1, v2, and v3) of top-most vertices of the polygon mesh A, r2, and r3 It asks.
]15] If this is all forward or negative, v will intersect a polygon with the polygon mesh B.
]16] If matrix representation of the v=r1 c+r2 c'+r3 c" is carried out, it will become as it is shown in Table 1.
]17]
ıble 1]

$$\begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} = \begin{pmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{pmatrix} \begin{pmatrix} r_1 \\ r_2 \\ r_3 \end{pmatrix}$$

erefore, r1, r2, and r3 What is necessary is just to apply an inverse matrix for asking.
]18] That is, it becomes Table 2.
]19]
ıble 2]

$$\begin{pmatrix} \cdot_1 \\ \cdot_2 \\ \cdot_3 \end{pmatrix} = \begin{pmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{pmatrix}^{-1} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

d when judged with crossing, it asks for the intersection of a method-of-averaging line and the polygon mesh B in the eshold judging means 14, and judges further whether the distance by the intersection is below the threshold defined orehand. When you are below a threshold, let the intersection be corresponding points. Connection processing is not formed when one does not have such corresponding points.
]20] Hereafter, how to ask for this intersection is explained. The vector from the top-most vertices P of the polygon sh A to the intersection for which it asks is applied with tv using a certain constant t. Therefore, although the vector he top-most vertices C of a polygon where a normal crosses serves as c-tv from the intersection for which it asks, ce this vector is on the polygon, n, then its inner product are set to 0 in the normal vector of a polygon. That is, (c-tv, =0 is realized. Since this can deform with (c, n)-t(v, n) =0, t=(c, n)/(v, n) is obtained. Therefore, the vector of the ersection for which it asks is set to (c, n)/(v, n) -v.
]21] Next, in the polygon mesh deformation means 15, the polygon mesh A is transformed by moving the endpoint of polygon mesh A to the intersection for which it asked with the threshold judging means 14.
]22] Furthermore, a migration parameter is set as each top-most vertices of A on the basis of the moved top-most tices of the polygon mesh A, and if it moves according to the migration parameter and the polygon mesh A is nsformed, a connection part can be smoothed more.
]23] The setting approach of a migration parameter is as follows. When the neighbor of opposite Perilla frutescens) Britton var. crispa (Thunb.) Decne. is first investigated on each top-most vertices of A and what is migration top-st vertices (let this be the migration parameter 0) in a neighbor exists, the migration parameter of the top-most tices is set to 1, and when migration of the top-most vertices of the migration parameter 0 is tu further, only 0.5 tu ves. When the neighbor of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. is investigated on gration parameter non-set up top-most vertices like the following and that whose migration parameter is p-1 in a ghbor exists, p is set up as a migration parameter and it moves only 0.5 times of the movement magnitude of the gration parameter p-1 further. It continues until the top-most vertices this [whose] is not set up are lost. By carrying like this, the top-most vertices of the migration parameter p serve as 0.5P tu, and migration according to a migration ameter can be performed.
]24] And in the garbage deletion means 16, the overlapping polygon is deleted as a result of the polygon mesh ormation means 15.
]25] Furthermore, a polygon is newly generated for the clearance which produced the new polygon in the generation ans 17 as a result of the garbage deletion means 16, stopgap processing is performed, the data of the top-most tices in the same location of the polygon mesh A and B are unified in the polygon mesh-data unification means 18, l it unites with one polygon mesh data.

)26] Drawing 3 thru/or drawing 6 show the example of a gestalt of operation of the 2nd of the polygon mesh contact this invention. In the polygon mesh contact of the example of a gestalt of the 2nd operation, the new polygon ıeration means 17 is made unnecessary by having the polygon mesh division means 21 between the polygon mesh ormation means 15 of the polygon mesh contact of the example of a gestalt of the 1st operation, and the garbage etion means 16.

)27] That is, in addition to the polygon mesh contact of the example of a gestalt of the 1st operation, along with the file of a polygon, it has a polygon mesh division means 21 to divide the polygon of another polygon mesh B for ınection, and is the polygon mesh contact which does not need the new polygon generation means 17 of the example a gestalt for the 1st operation as the result.

)28] As a result of the polygon mesh deformation means 15, as shown in drawing 4 , two top-most vertices (referred ıs E and F) of a polygon with the polygon mesh (meshA) A When moving onto the polygon from which the polygon sh B differs In the polygon mesh division means 21, the minimum distance of the Edges E and F and edge of the ygon of the polygon mesh (meshB) B of a migration place is found. The point on the edge of the polygon mesh B ich takes the minimum distance is generated as new top-most vertices H, and Polygons G, E, and H, and G, F and H generated further. Then, Polygons E, F, and G are deleted.

)29] Then, as shown in drawing 5 , in order to make polygon division of the polygon mesh B easy to perform, the ygon of the polygon mesh A is operated orthopedically.

)30] First, the polygon of the polygon mesh B of the migration place of the top-most vertices of opposite Perilla tescens (L.) Britton var. crispa (Thunb.) Decne. is investigated to each polygon of the polygon mesh A. The polygon leleted when moving into the polygon of the same polygon mesh B also as three top-most vertices. When it is moving he polygon with two same top-most vertices and one of top-most vertices are on the edge of the polygon mesh B is is set to S, it twists on an edge and the top-most vertices of the direction are set to T), the polygon P which makes it edge after [S and T] moving top-most vertices T to S is deleted.

)31] Next, division of the polygon mesh B is explained using drawing 6 . When new top-most vertices of the polygon sh A are generated on the edge to each edge of the polygon mesh B, the new top-most vertices W of the polygon sh B are generated in the location, an edge is generated between top-most-vertices W' which is in the other side on an ge further, and top-most vertices W, polygon division is performed, and mesh fragmentation of a connection part is formed. And top-most vertices V are generated, an edge is generated between top-most-vertices V' which is in the er side on an edge further, and top-most vertices V, and polygon division is performed.

)32] Therefore, since the polygon mesh B is divided along with the profile of the polygon mesh A, even if it performs garbage deletion means 16, a clearance is not generated, and the new polygon generation means 17 does not have need of carrying out.

)33]

fect of the Invention] Since it matches and the method line of an average is used in this invention by projecting the file of a polygon mesh on the polygon mesh for connection in the direction of a method-of-averaging line, it is rare ɔe influenced of a noise.

)34] Moreover, since a garbage is deleted after performing polygon division along with the profile of a polygon mesh orehand, a polygon does not lap in a connection part.

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NOTICES *

This document has been translated by computer. So the translation may not reflect the original precisely.
*** shows the word which can not be translated.
n the drawings, any words are not translated.

AWINGS

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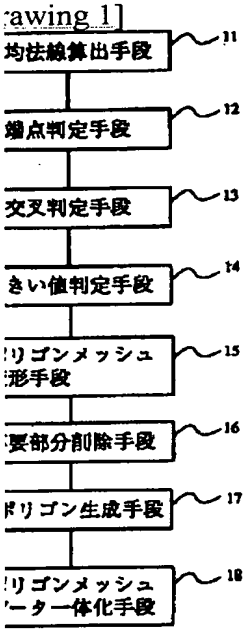
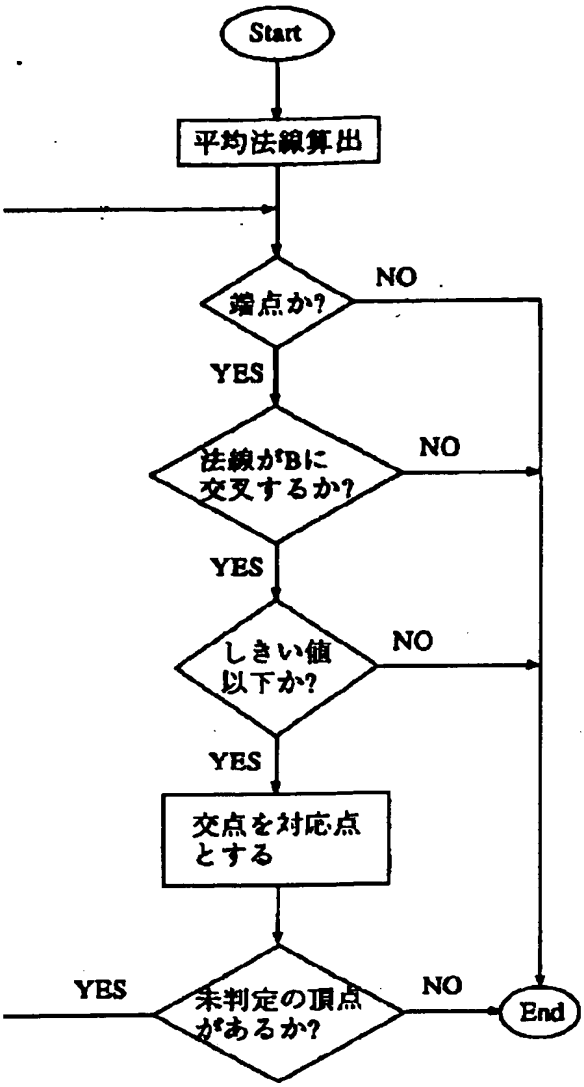
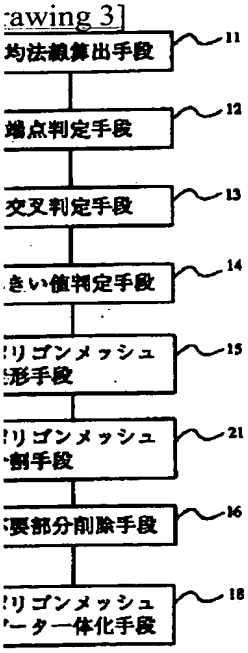
rawing 1]



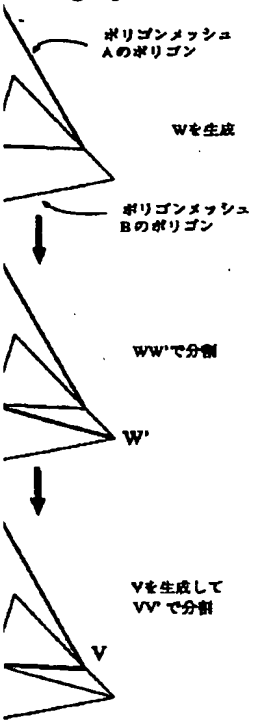
rawing 2]


Start
平均法線算出
端点か?
NO
YES
法線がBに
交叉するか?
NO
YES
しきい値
以下か?
NO
YES
交点を対応点
とする
YES
未判定の頂点
があるか?
NO
End

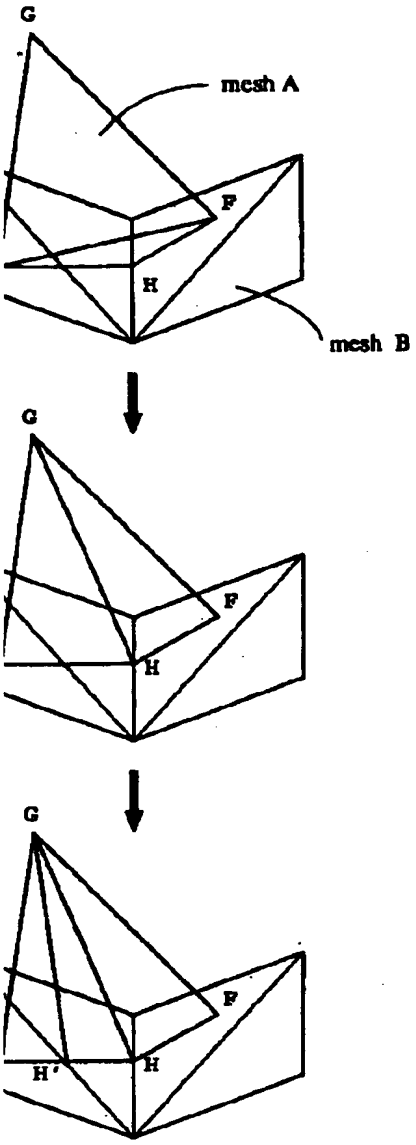
[Drawing 3]


均法線算出手段
11
端点判定手段
12
交叉判定手段
13
きい値判定手段
14
リゴンメッシュ
形手段
15
リゴンメッシュ
創手段
21
要部分削除手段
16
リゴンメッシュ
ータ一体化手段
18

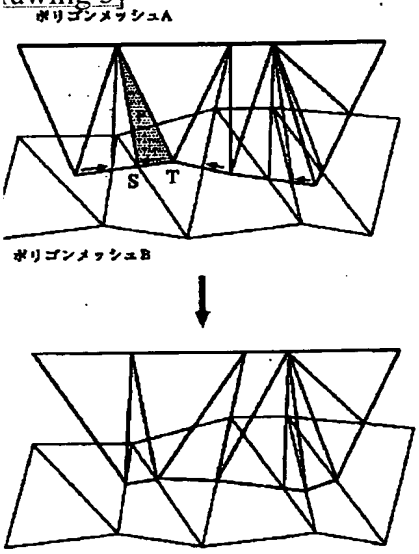
awing 6]



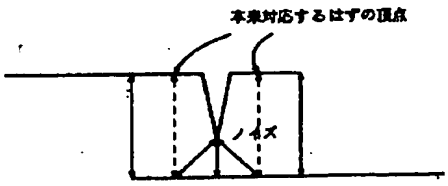
awing 4]

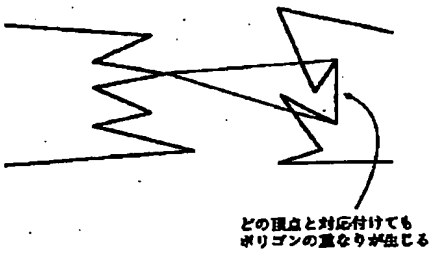


rawing 5]



rawing 7]





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